***Official copies of these procedures are maintained at this website. Before using a printed copy, verify that it is the most current version by checking the document issue date on this website. Signed copies of these official procedures are maintained at the Training Office***

C-A OPERATIONS PROCEDURES MANUAL

ATTACHMENT

9.2.4.a Considerations When Making An ESRC Check-Off List

| C-A OPM Procedures in which this Attachment is used. |
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| 9.2.4 | | |
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Hand Processed Changes

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Approved: _____Signature On File_____ _____
Collider-Accelerator Department Chairman Date

Y. Makdisi

## Considerations When Making an ESRC Check-Off List

**Environmental Issues**

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| Safety Issues: | • Loss of radioactive cooling water or fire-protection water<br>• Inadvertent radioactive or gaseous air emissions<br>• Loss of radioactive waste or hazardous waste to ordinary waste stream<br>• Induced activity in soil and subsequent contamination of ground water<br>• Loss of hazardous material to trenches or to soil and ground water |
| Potential Initiators of Safety Problems: | • Loss of pressure on domestic water supply<br>• Violation of procedures for removal of waste from experiments<br>• Cooling-water-pipe break and loss of water to a storm sewer and recharge basin<br>• Inadequate containment between experimental structures and the contiguous earth<br>• Broken gas line or gas filled chamber |
| Potential Items To Go On the ESRC Check-Off List: | • Containment structure to protect soil and groundwater<br>• Special shields to reduce soil activation to as low as reasonably achievable<br>• Formal design reviews for modifications<br>• Drawing configuration control<br>• Domestic water supply equipped with back-flow preventers to isolate the laboratory domestic water supply systems<br>• A system to hold-up spilled liquids<br>• A system for normal and emergency gas ventilation<br>• Experiment specific waste-handling training for Users<br>• Lock-down of ordinary waste stream, hazardous waste stream and radioactive waste stream<br>• Removal of or blocking-off storm-sewer drain-lines near experiment<br>• Alarms on local sumps and manual starting of sump pumps<br>• Air or water Permits in place if required<br>• Water-impermeable barrier to prevent rain water from leaking radioactivity in soil.<br>• compliance w/Suffolk County Article 12<br>• Alarms on water systems to detect leaks and alert operations personnel.<br>• Isolated closed cooling-water systems to reduce the volume of tritiated water.<br>• See Pollution Prevention web-page<br>• Process Evaluation by Environmental Compliance Representative<br>• Significant Aspects of targets and/or control devices. |

**Personnel Exposure Issues**

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| Safety Issues: | • Accidental exposure of workers to contamination or toxic materials<br>• Un-permitted environmental release |
| Potential Initiators of Safety Problems: | • Failure to follow the design review procedures<br>• Improper fabrication of experimental devices<br>• High temperatures or pressures<br>• Cooling pipe break on systems with ethylene glycol<br>• Oil leak from capacitors, transformers, pumps, motors<br>• Unsafe practices for handling hazardous and toxic materials<br>• Fire near uranium shield blocks or uranium calorimeters |
| Potential Items To Go On the ESRC Check-Off List: | • Chief Mechanical Engineer certifies vessels, pressure chambers and experimental chambers<br>• Chief Mechanical Engineer certifies construction and testing procedures<br>• Gas flow limits<br>• Users trained on procedure for operation of gas or gas-mixing systems<br>• Fail-safe temperature or pressure interlocks<br>• Approved User procedures and training for handling hazardous materials<br>• BNL Hazard Communication Training for Users<br>• Labeling of experimental pipes and vessels as to contents<br>• ESRC inspection of chemical and hazardous materials inventories<br>• Minimal combustible loading in experimental area<br>• Users trained in appropriate emergency procedures |

**Flammable Or Combustible Materials Issues**

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| Safety Issues: | • Loss of life or severe injury<br>• Damage to components or facilities<br>• Impact on the physics program due to fire-related interruptions |
| Potential Initiators of Safety Problems: | • The primary initiators in a fire are damaged or improperly connected electrical cables<br>• Ignition of flammable gases in the experiments<br>• Ignition of flammable liquids inside refrigerators |
| Potential Items To Go On the ESRC Check-Off List: | • Sprinkler and halon protection systems for the existing high-value experimental areas<br>• High sensitivity fire detection systems<br>• Selection of materials which reduce the potential for flame spread<br>• Emergency exhaust ventilation systems<br>• The use of strategically located exits and audible alarms to reduce the potential for loss of life during an emergency<br>• Elimination of potential ignition sources in experimental areas<br>• On-site fire/rescue organization notified on movement of flammable materials on the experimental floor<br>• Emergency planning and drills<br>• Limits on flammable gas or liquid inventory and on flow rates on the experimental floors<br>• Requirements for safety review of any modification on:<br>• use of flammable gases or liquids<br>• installed equipment or material containing wood, plastic, paper, or other combustible matter in significant quantities<br>• Compliance with the Life Safety Code, NFPA 101, Chapters 1-6<br>• Compliance with the DOE Improved Risk level of fire protection<br>• Use of fire wire fire-detection systems<br>• Electrical energy interlocks tripped by heat or smoke detectors<br>• Using refrigerators or containers that meet the criteria of Underwriters Laboratories or Factory Mutual for flammable materials<br>• Identifying and posting hazardous locations for flammable or combustible materials storage or use<br>• Written procedures to temporarily impair fire detection or fire protection systems<br>• Fire watch |

**Electrical Energy Issues**

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| Safety Issues: | • Electrocution death and injury<br>• Electrical arcing and molten-metal spray injury |
| Potential Initiators of Safety Problems: | • Unsafe practices |
| Potential Items To Go On the ESRC Check-Off List: | • Approved procedures and training for specific tasks involving electrical safety issues<br>• Control zones around energized parts with signs and barriers<br>• Generic procedures and training used to cover many tasks with similar electrical hazards<br>• Use of permits to work hot<br>• Performance of a job safety-analysis in order to identify and mitigate the hazard of electrocution<br>• Lock out and tag out procedures<br>• Equipment and training to isolate the source of energy in the system<br>• Use of a safety watch or two-man rule where appropriate<br>• Experimenters not allowed to work on power distribution or connection to electrical power<br>• Have Chief Electrical Engineer certify all non-ul or services custom built<br>• Appropriate barriers are installed |

**Oxygen Depletion Issues**

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| Safety Issues: | • Asphyxiation |
| Potential Initiators of Safety Problems: | • Inadvertent entry into gas-filled detector<br>• Accidental release of He or N gas |
| Potential Items To Go On the ESRC Check-Off List: | • Cerenkov detectors are posted as Class 2 Confined Spaces according to BNL ES&H Standards<br>• Entry procedure required<br>• Written procedures shall exist for purging hazardous gases, (eg. $CO_2$ and H) from the detectors<br>• Design reviews and functional testing before operations<br>• ODH area designations<br>• ODH training |

**Hydrogen Target Issues**

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| Safety Issues: | • Physical injury (e.g., eye injury, broken bones, etc.)<br>• Burns |
| Potential Initiators of Safety Problems: | • Fire near a hydrogen target |
| Potential Items To Go On the ESRC Check-Off List: | • Target vacuum sensors<br>• Hydrogen gas detectors in vent lines<br>• Fire wire around nearby experimental equipment<br>• No smoking or open flame boundaries defined and posted<br>• Separate hydrogen target enclosure that meets Class I Division II criteria for electrical circuits in explosive atmospheres<br>• Controls on the introduction of ordinary equipment into the hydrogen target enclosure<br>• Fire detectors in and around the target enclosure<br>• Interlocks to turn off power to potential ignition sources near the target should a fire develop, a vacuum leak be detected, or hydrogen gas be detected<br>• Automatic, fail-safe venting of hydrogen gas out a vent stack should that be required<br>• A round-the-clock target watch by trained target-watch personnel who have procedures to respond to alarms<br>• Hydrogen Target Control Console at each experiment operated by authorized C-A personnel only<br>• Written procedures for the Cryogenic Group; for example, target handling, hydrogen venting, target filling, testing for hydrogen gas leaks, etc.<br>• Target designs reviewed and approved by the BNL Cryogenic Safety Committee<br>• Design reviews and functional testing before operations<br>• Experimental Hall evacuation alarms and training for Users and staff<br>• Verification of alarm annunciation in MCR |

**Magnetic Fields and Electromagnetic Radiation Issues**

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| Safety Issues: | • Reaction with medical implants<br>• Magnetic pull of heavy metal object through persons hand and into magnet iron with resultant crush type-injury of hand<br>• Hyperthermia, Cataracts, Lenticular Opacities (rf)<br>• Destruction of retina (lasers) |
| Potential Initiators of Safety Problems: | • Inadvertent exposure to stray magnetic field near spectrometer magnet<br>• Exposure to rf radiation or laser light from improperly enclosed devices |
| Potential Items To Go On the ESRC Check-Off List: | • Areas with strong magnetic fields are to be fenced and posted with appropriate warnings<br>• Magnets shall undergo an environmental review before turn on to ensure signs and warnings are present and to ensure loose ferrous objects are not present<br>• Measurement of magnetic fields around spectrometer magnets to ensure fencing and posting are located appropriately<br>• Design reviews and functional testing before operations<br>• Doors are posted with warnings for persons using a cardiac pacemaker<br>• Local barriers are placed around rf stations<br>• RFI gaskets are used on equipment to prevent rf radiation leakage<br>• Routine monitoring for rf radiation to determine if gaskets are effective<br>• Interlocks on laser barriers<br>• Eye protection for laser Users<br>• Appropriate laser RF postings |

**Thermal Energy Issues**

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|---|---|
| Safety Issues: | • Burns<br>• Fires |
| Potential Initiators of Safety Problems: | • Spills of cryogenic liquids<br>• Contact with cold lines associated with liquid cryogenic systems<br>• Contact with hot surfaces of machinery<br>• Contact with soldering irons<br>• Improper protective clothing for cutting and welding operations |
| Potential Items To Go On the ESRC Check-Off List: | • Insulation on cold/hot surfaces<br>• Review of installation/procedures by the safety committee<br>• Design reviews and functional testing before operations<br>• Cutting and welding conducted by trained personnel only<br>• Boundaries for cutting and welding are posted<br>• Cutting and welding permit required prior to job<br>• Proper fire protection provided |

**Kinetic Energy Issues**

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|---|---|
| Safety Issues: | • Physical injury (e.g., eye injury, broken bones, hearing loss, fatal injury, etc.) |
| Potential Initiators of Safety Problems: | • Mis-operation of power tools or motorized equipment<br>• Pressure testing with inappropriate vessels or piping<br>• Inadvertent contact with rotating or moving machinery<br>• Improper rigging of experimental apparatus or shielding<br>• Failure to wear proper personnel protective equipment |
| Potential Items To Go On the ESRC Check-Off List: | • Machine guards<br>• Only trained personnel allowed to operate tools, motorized experimental equipment or perform rigging operations<br>• Written procedures or Experiment Spokesperson participation in large equipment moves<br>• Chief Mechanical Engineer certification of large equipment moves<br>• Design reviews and functional testing before operations<br>• Users trained in personnel protective equipment requirements |

**Potential Energy Issues**

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|---|---|
| Safety Issues: | • Physical injury (e.g., eye injury, broken bones, hearing loss, etc.) |
| Potential Initiators of Safety Problems: | • Release of stored energy associated with compressed gases or large vacuum spaces<br>• Puncture of a vacuum window<br>• Improper hoisting operation<br>• Failure to wear proper personnel protective equipment |
| Potential Items To Go On the ESRC Check-Off List: | • All pressure and vacuum equipment is designed to applicable codes and standards<br>• Operation and design reviewed by safety committees<br>• Design reviews and functional testing before operations<br>• Training and adherence to procedures by operators of compressed gas systems<br>• Window covers on vacuum windows<br>• Chief Mechanical Engineer certification of thin vacuum windows<br>• Chief Mechanical Engineer certification of vacuum or pressure vessels<br>• Written procedures for pressure testing or vacuum window testing<br>• Written procedures for in-house assembly of vacuum or pressure vessels<br>• Only trained personnel allowed to perform hoisting operations<br>• Users trained in personnel protective equipment requirements |